



CASE REPORT

Co-contraction of swallowing musculature and trapezius following basal skull fracture

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Introduction

The spinal accessory nerve arises from motor neurons in the cervical spinal cord. It enters the posterior cranial fossa through the foramen magnum, then exits through the jugular foramen. It lies in close relation to the vagus and glossopharyngeal nerves within the foramen. Fractures in this region may damage these nerves. Reinnervation, either from other nerves or from fibres previously innervating other structures, can be aberrant, providing the potential for co-contraction.^{5,6} This unusual case illustrates co-contraction of swallowing muscles and trapezius following a basal skull fracture, which has not been reported previously.

Case report

A 27-year-old, right-handed, female teacher was knocked down by a motor car in August 2003. Her general health was excellent. Her injuries included: a basal skull fracture, C2 fracture, compound fracture of the left humerus with radial nerve palsy, left ulna styloid fracture, and left fifth metacarpal fracture. The fracture of the humerus was treated by internal fixation, and by skin grafting of the wound. The skull base, C2 and left wrist fractures were managed non-opera-

tively. Protrusion of the right scapula was noted following her accident, and nerve conduction studies and electromyography (EMG) were performed in February, 2004. These confirmed moderate partial denervation of the right upper trapezius with some evidence of reinnervation; the middle and lower portions of trapezius and serratus anterior appeared normal. Median and ulnar nerve motor and sensory nerve conduction studies were normal.

The patient was seen in our unit 24 months after injury with persistent right shoulder pain, protrusion of the scapula, and the development of aberrant muscle activity on swallowing. Her pain was graded as Visual Analogue Scale (VAS; where 0 is no pain, and 10 the worst pain imaginable) four, rising to seven/eight, Peripheral Nerve Injury (PNI) pain score¹ two, and she required analgesia approximately twice per week. She reported jerking of the chin and elevation of the right shoulder with swallowing, whether eating, drinking or at rest. In addition, the patient commented that in the months following injury she was aware of abnormal intermittent sensations and pins and needles around the chin, which subsequently settled.

On examination, there was winging of the right scapula, with wasting and weakness of the right sternocleidomastoid and upper trapezius. Abduction of the glenohumeral joint was limited to 90°; the inferior scapulo-humeral angle measured 90°. Forward flexion reached 180°. At rest, the right scapula was located 3 cm from the spine, equal to the other side, and was depressed by 1 cm relative to the unaffected left side. In abduction, the superior pole elevated by 4 cm,

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Figure 1 Showing co-contraction of the swallowing muscles, sternocleidomastoid and trapezius.

with lateral displacement of 3 cm (superior pole), and of 2 cm (inferior pole). Swallowing caused involuntary co-contraction of the right trapezius and sternocleidomastoid muscles. The right sternocleidomastoid, although very wasted, caused the chin to jerk away from the affected side during swallowing. Co-contraction of trapezius lifted the right shoulder (Fig. 1).

Neurophysiological studies were repeated at 30 months from injury. These confirmed chronic partial denervation in the right upper trapezius. Needle EMG recordings from the right trapezius during swallowing revealed aberrant reinnervation of these fibres, which were recruited upon swallowing. The sternocleidomastoid muscle was not examined because it was too wasted.

Discussion

The spinal accessory nerve arises from a column of motor neurons, located in the lateral part of the grey matter of the cervical spinal cord (C1–C6). Rootlets form a trunk, which ascends between dorsal and ventral rootlets, through the foramen magnum adjacent to the vagus nerve, to enter the posterior cranial fossa. The spinal component then joins the cranial root, and the common trunk exits the base of the skull through the intermediate part of the jugular foramen, together with the glossopharyngeal and vagus nerves. The inferior petrosal sinus lies anteriorly, and the internal jugular vein in the posterior portion. In the case described, the lesion was severe, but partial, and was located at or adjacent to the

jugular foramen. The weakness of both sternocleidomastoid and trapezius suggests a high lesion. The involuntary activity of these muscles with swallowing indicates abnormal synchronous activity between the spinal accessory nerve (cranial nerve XI) and the glossopharyngeal and vagus nerves (cranial nerves IX and X). There are a number of possible explanations for this synkinesis, namely, that after the injury to the spinal root, there was aberrant reinnervation by motor fibres from the cranial root of the accessory nerve, or reinnervation from the motor fibres of the vagus or glossopharyngeal nerves. This case may also have resulted from abnormal cortical plasticity.

It has been postulated that the cranial root of the accessory nerve may not exist in the human, the relevant fibres being further rootlets of the vagus or glossopharyngeal nerves.⁹ If the explanation that there is reinnervation from the cranial root of the accessory nerve is accepted, this case report may support the existence of these fibres in the human.

On reaching the retrostyloid space, the two roots of the accessory nerve separate, the spinal accessory nerve running inferiorly, anterior or posterior to the internal jugular vein. It crosses the transverse process of the atlas and descends medial to the styloid process, stylohyoid, and the posterior belly of digastric, to the upper part of the sternocleidomastoid muscle. In the region of the proximal sternocleidomastoid, the spinal accessory nerve may form an anastomosis with fibres from C2 and/or C3, the Ansa of Maubrac. Typically, it emerges around the midpoint of the posterior border of sternocleidomastoid, coursing obliquely across the posterior triangle of the neck on levator scapulae, separated from it by the prevertebral layer of deep cervical fascia and adipose tissue, in close relation to the superficial cervical lymph nodes. At 3–5 cm above the clavicle it penetrates the fascia of the anterior border of trapezius, running between the muscle and fascia. A cervical branch (C3 and C4 or C4 alone) joins the spinal accessory nerve about 2 cm above the clavicle. In this case, the EMG studies were normal in the middle and lower fibres of trapezius at both examinations, suggesting that there was dual innervation of the middle and lower portions of the muscle. Soo et al.⁸ showed a cervical contribution either just proximal to or deep to sternocleidomastoid (C2 and/or C3 fibres), or as is most likely in this case, at approximately 2 cm above the clavicle (C3 and/or C4 fibres).

The patient's description of sensory symptoms in the early period post-injury may indicate involvement of the trigeminal nerve. Brown et al.² found that the anterior rami of C2–4 of the cervical plexus may interconnect with the peripheral branches of the trigeminal nerve. An alternative explanation is that some sensory fibres from the trigeminal nerve enter the spinal trigeminal nucleus at the level of upper cervical spinal cord, and therefore could have been involved in the original injury.

This specific form of aberrant reinnervation has not been previously documented. There are few reports of co-contraction of cranial nerves following basal skull fracture. A small number of studies have reported multiple cranial nerve palsies with or without associated cervical spine injury,^{4,7} but have not described aberrant reinnervation. However, regional reinnervation syndromes have been reported, such as the "breathing arm".³

Conclusion

The case detailed above illustrates the functional importance of considering associated cranial nerve injuries with basal skull fractures. It demonstrates the unusual phenomenon of aberrant reinnervation. By evaluation of the clinical and neurophysiological data, the anatomy of the spinal component of the accessory nerve can be better understood.

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